

CLAIMS

1. A method of forming a pattern for a semiconductor device, comprising:

the step of forming a photosensitive film on a substrate; and

the step of radiating the photosensitive film on the substrate with a beam of a predetermined shape obtained from one of a charged particle beam and an electromagnetic beam, thereby forming an exposed region of a desired shape, the step including the step of exposing each of unit regions by a single shot of the beam of the predetermined shape for a predetermined period of time, repeating the exposure a plurality of times, and butt-joining the exposed unit regions to thereby form the exposed region of the desired shape;

wherein, in the step of forming the exposed region of the desired shape, butting portions of the unit regions are situated in a first area of a layer to be formed other than a second area of the layer in which predetermined characteristics of a function of the semiconductor device are determined by a pattern width of the exposed region in association with another pattern formed in another layer.

2. The method according to claim 1, wherein the first area in which the butting portions of the unit regions are situated corresponds to an isolation region employed in the semiconductor device.

3. The method according to claim 1, wherein the second area in which the predetermined characteristics of the predetermined function are determined by the pattern width of the exposed region corresponds to an active region incorporated in a transistor in the semiconductor device.

4. The method according to claim 1, wherein the second area in which the predetermined characteristics of the predetermined function are determined by the pattern width of the exposed region corresponds to an electrode region to which an interlayer contact in the semiconductor device is connected.

5. The method according to claim 1, wherein the step of forming the photosensitive film on the substrate uses a positive-type photosensitive material.

6. The method according to claim 1, wherein the step of forming the photosensitive film on the substrate uses a negative-type photosensitive material.

7. A method of forming a pattern comprising:
the step of forming a photosensitive film on a substrate; and

the step of radiating the photosensitive film on the substrate with a beam of a predetermined shape obtained from one of a charged particle beam and an electromagnetic beam and emitted from a writing tool, thereby forming an exposed region of a desired shape, the step including the step of exposing each of

unit regions by a single shot of the beam of the predetermined shape for a predetermined period of time, repeating the exposure a plurality of times, and butt-joining the exposed unit regions to thereby form the exposed region of the desired shape;

wherein the step of forming the exposed region of the desired shape includes the step of subjecting predetermined ones of the unit regions to single shot exposure, and subjecting the other ones of the unit regions to multiple shot exposure.

8. The method according to claim 7, wherein in the step of forming the exposed region of the desired shape, the multiple shot exposure is performed by repeating the same shot exposure in the same position.

9. The method according to claim 7, wherein in the step of forming the exposed region of the desired shape, the multiple shot exposure is performed by changing the butting position of the unit regions in units of a single shot exposure treatment.

10. The method according to claim 7, wherein the step of forming the exposed region of the desired shape selectively uses multiple shot exposure in which the same shot exposure is repeated in the same position, and multiple shot exposure in which the butting position of the unit regions is changed in units of a single shot exposure treatment.

11. The method according to claim 7, wherein

the step of forming the photosensitive film on the substrate uses a positive-type photosensitive material.

12. The method according to claim 7, wherein the step of forming the photosensitive film on the substrate uses a negative-type photosensitive material.

13. The method according to claim 7, wherein the step of forming the photosensitive film on the substrate includes the step of using a combination of manners of optical overlap of first and second apertures employed in the writing tool to form the beam of the predetermined shape, and the same combination of the manners of optical overlap of the first and second apertures is used at the time of subjecting to single shot exposure those of the unit regions which have the same shape.

14. An apparatus for forming a pattern for a semiconductor device, comprising:

beam shaping means for shaping, to a predetermined shape, one of a charged particle beam and an electromagnetic beam;

positioning means for positioning the position of the beam of the predetermined shape in a single unit region of a substrate with a photosensitive film formed thereon; and

shot exposure means for radiating the single unit region with the beam for a predetermined period of time;

wherein the shot exposure means repeats shot exposure in units of a single unit region to thereby form a desired exposed region; and

the positioning means sequentially forwards the position in which the beam is to be radiated, butt-joins the single unit region to another single unit region to form a plurality of butt-joined unit regions, and situates butting portions of the butt-joined unit regions constituting the desired exposed region, in a first area of a layer to be formed other than a second area of the layer in which predetermined characteristics of a function of the semiconductor device are determined by a pattern width of the exposed region in association with another pattern formed in another layer.

13 → 15. The method according to claim 14, wherein the positioning means causes the second area in which the butting portions of the unit regions are formed, to correspond to an isolation region employed in the semiconductor device.

16. The method according to claim 14, wherein the positioning means determines the position of the beam such that the second area in which the predetermined characteristics of the predetermined function are determined by the pattern width of the exposed region corresponds to an active region incorporated in a transistor in the semiconductor device.

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5 17. The method according to claim 14, wherein the positioning means determines the position of the beam such that the region in which the predetermined characteristics of the predetermined function are determined by the pattern width of the exposed region corresponds to an electrode region to which an interlayer contact in the semiconductor device is connected.

10 18. An apparatus for forming a pattern comprising:
beam shaping means for shaping, to a predetermined shape, one of a charged particle beam and an electromagnetic beam;

15 positioning means for positioning the position of the beam of the predetermined shape in a single unit region of a substrate with a photosensitive film formed thereon; and

shot exposure means for radiating the single unit region with the beam for a predetermined period of time;

20 wherein the shot exposure means subjects predetermined ones of the unit regions to single shot exposure, and the other ones of the unit regions to multiple shot exposure, and

25 the positioning means sequentially forwards the position in which the beam is to be radiated, and butt-joins the single unit region to another single unit region to form a plurality of butt-joined unit regions.

19. The apparatus according to claim 18, wherein the shot exposure means performs the multiple shot exposure by repeating the same shot exposure in the same position.

5 20. The apparatus according to claim 18, wherein the shot exposure means performs the multiple shot exposure by changing the butting position of the unit regions in units of a single shot exposure treatment.

10 21. The apparatus according to claim 18, wherein the shot exposure means performs the multiple shot exposure by selectively using multiple shot exposure in which the same shot exposure is repeated in the same position, and multiple shot exposure in which the butting position of the unit regions is changed in
15 units of a single shot exposure treatment.

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